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# FLOOD INSURANCE STUDY

## TOWNSHIP OF LACKAWAXEN, PENNSYLVANIA
### PIKE COUNTY

AUGUST 4, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 421966
COMPLETED
ORIGINAL

## NOTICE TO
## FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

## TABLE OF CONTENTS


| | | |
|---|---|---|
| 1.0 | INTRODUCTION | 1 |
| | 1.1 Purpose of Study | 1 |
| | 1.2 Authority and Acknowledgments | 1 |
| | 1.3 Coordination | 1 |
| 2.0 | AREA STUDIED | 2 |
| | 2.1 Scope of Study | 2 |
| | 2.2 Community Description | 2 |
| | 2.3 Principal Flood Problems | 4 |
| | 2.4 Flood Protection Measures | 4 |
| 3.0 | ENGINEERING METHODS | 5 |
| | 3.1 Hydrologic Analyses | 5 |
| | 3.2 Hydraulic Analyses | 6 |
| 4.0 | FLOODPLAIN MANAGEMENT APPLICATIONS | 7 |
| | 4.1 Floodplain Boundaries | 7 |
| | 4.2 Floodways | 9 |
| 5.0 | INSURANCE APPLICATIONS | 12 |
| 6.0 | FLOOD INSURANCE RATE MAP | 14 |
| 7.0 | OTHER STUDIES | 14 |
| 8.0 | LOCATION OF DATA | 14 |
| 9.0 | BIBLIOGRAPHY AND REFERENCES | 15 |

TABLE OF CONTENTS - continued

FIGURES

Figure 1 - Vicinity Map 3

Figure 2 - Floodway Schematic 12

TABLES

Table 1 - Summary of Discharges 6

Table 2 - Regulatory Data 8

Table 3 - Floodway Data 10 - 11

EXHIBITS

Exhibit 1 - Flood Profiles
Lackawaxen River Panels 01P-13P
Delaware River Panels 14P-17P

Exhibit 2 - Flood Insurance Rate Map Index and Street Index
Flood Insurance Rate Map

Exhibit 3 - Elevation Reference Marks

FLOOD INSURANCE STUDY
TOWNSHIP OF LACKAWAXEN, PIKE COUNTY, PENNSYLVANIA

## 1.0 INTRODUCTION

### 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Lackawaxen, Pike County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

### 1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for Indian Orchard Brook were prepared by the Philadelphia District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 16. The hydrologic and hydraulic analyses for the Delaware River were prepared by the U. S. Geological Survey (USGS) during the preparation of the Flood Insurance Studies for the Towns of Highland and Tusten, New York. The work for this study was completed in April 1987.

### 1.3 Coordination

An initial Consultation and Coordination Officer's (CCO) meeting was held in December 1984 with representatives of FEMA and the township to identify the streams to be studied by detailed methods. A search for basic data was made at all levels of government. Maps were obtained from the community and the USGS. On September 2, 1987, a final CCO meeting was held with representatives of FEMA, the township, and the COE (the study contractor) to review the results of the study.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Lackawaxen, Pike County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Lackawaxen River was studied by detailed methods for its entire length within the community. The Delaware River was studied by detailed methods from the downstream corporate limits to a point approximately 9,830 feet upstream and from a point approximately 37,060 feet upstream of the downstream corporate limits to the upstream corporate limits. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through April 1992.

The following flooding sources were studied by approximate methods: West Falls Creek, Decker Creek, Blooming Grove Creek, Balliard Creek, Masthope Creek, and the remaining portions of the Delaware River. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Lackawaxen.

### 2.2 Community Description

The Township of Lackawaxen is located at the northern tip of Pike County, covering an area of approximately 50,000 acres. It is bordered by the Towns of Tusten and Highland, New York, to the northeast; the Township of Shohola to the east; the Township of Blooming Grove to the south; the Township of Palmyra to the southwest; the Township of Berlin to the northwest; and the Borough of Hawley to the southwest. Lackawaxen had a population of 2,218 in 1982. It is a second class township governed by a three member board of supervisors.

The topography of the area is generally very steep with numerous mountain streams, scattered lakes, and swamp areas. There are scattered residential developments within the township, with the largest development located near Westcolong Pond. Lackawaxen is one of the fastest growing areas for permits issued for housing and is one of the leaders in second home developments in Pike County. Of the total land acreage within the township, approximately 5.5 percent (2,747 acres) are owned by the Bureau of Forestry, and approximately 4 percent (1,875 acres) are owned by the Pennsylvania Game Commission.

The Lackawaxen River flows in an eastern direction to its confluence with the Delaware River, which flows in a southern direction. Both streams flow through moderately steep terrain.

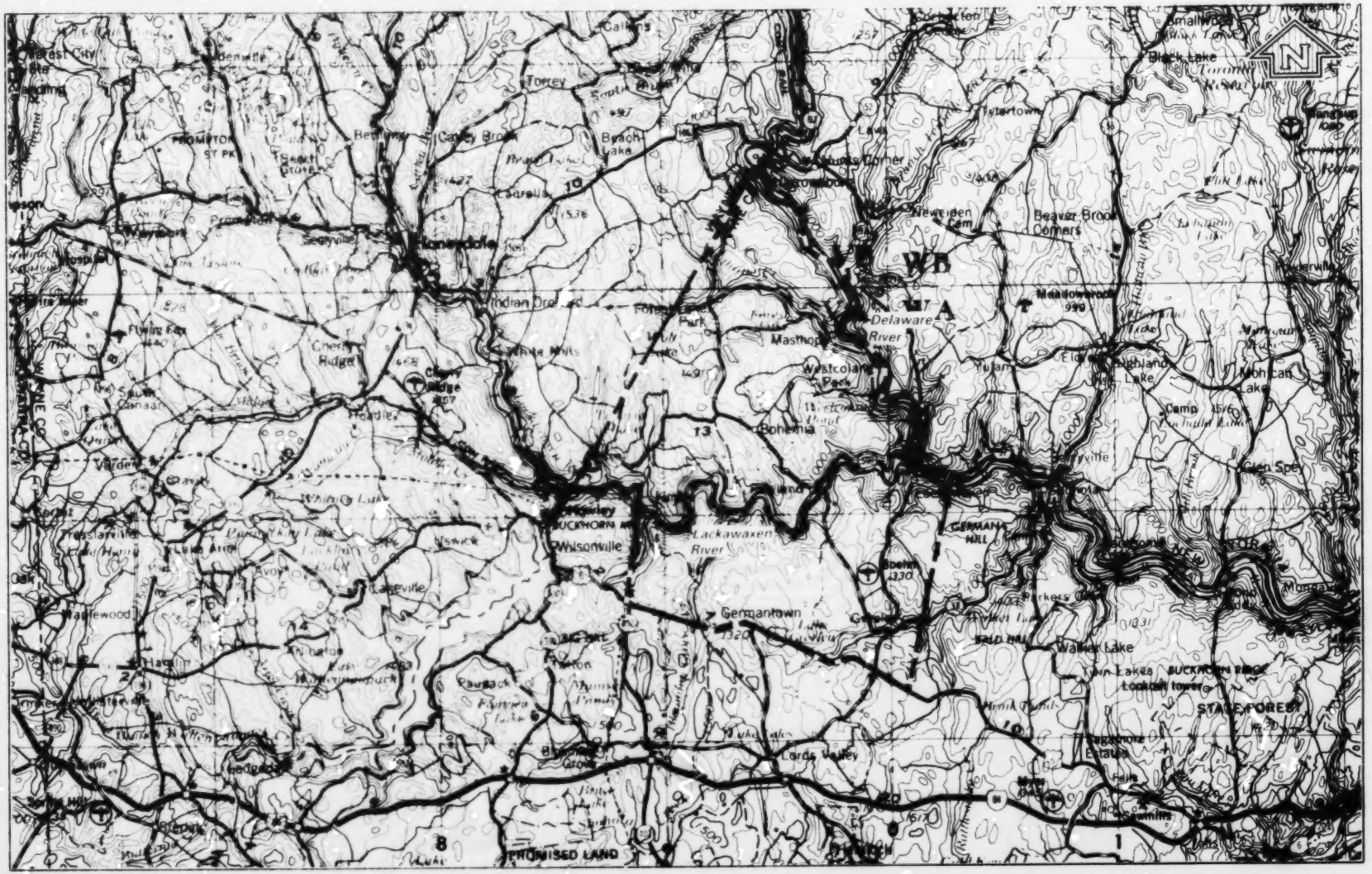



FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA

(PIKE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

## VICINITY MAP

The climate in this geographic area is characterized by temperatures ranging from an average high of 68 degrees Fahrenheit ($^{o}$F) in summer to an average low of 30$^{o}$F in winter. The average annual rainfall for the region is 44 inches.

## 2.3 Principal Flood Problems

The principal flood problems in the Township of Lackawaxen are associated with the Lackawaxen River and the Delaware River. USGS gaging station No. 01431500 is located on the Lackawaxen River at Hawley, approximately 700 feet upstream from its confluence with Wallenpaupack Creek. Records have been kept intermittently since 1908. These records indicate that the three greatest floods occurred in August 1955, May 1942, and March 1936, with the 1955 flood being the largest. Newspaper accounts also indicate severe flooding in October 1903.

USGS gaging station No. 0143400 is located on the Delaware River at Port Jervis, New York. This gage has a period of record from 1904 to present. These records indicate that the four highest storm related flood stages occurred in August 1955, October 1903, May 1942, and March 1936, respectively.

In addition, township officials reported that ice related flooding has occurred along the Lackawaxen River and the Delaware River. According to the gage records at Port Jervis, ice jams caused flooding in February 1981 and March 1904, which exceeded rainfall related flood stages.

## 2.4 Flood Protection Measures

New York City has several water-supply reservoirs in the Delaware River basin. These reservoirs significantly retard floodwaters along the Delaware River even though they were not originally intended as flood control structures. The Cannonsville Reservoir near Cannonsville, New York, and the Pepacton Reservoir near Downsville, New York, are two New York City reservoirs that have helped reduce flooding along the Delaware River since their construction in 1963 and 1964, respectively. Discharges on the Delaware River, downstream of the Lackawaxen River, are also regulated by Prompton, Jadwin, and Wallenpaupack Reservoirs, which are located in Pennsylvania on tributaries to the Lackawaxen River.

Although Wallenpaupack Reservoir is operated as a hydroelectric power project, not a flood control project, it does have a substantial impact on Lackawaxen River flows below Wallenpaupack Creek. There are two major flood control projects located within the Lackawaxen River Basin that affect flood flows within the community: Prompton Lake is located on the West Branch of the Lackawaxen River and General Edgar Jadwin Dam and Reservoir is

located on Dyberry Creek. Jadwin is a single purpose flood control project while Prompton has a dual purpose of flood control and recreation. Future modifications to Prompton will include a further purpose of water supply. Both of these dams are COE projects and were completed 1960. The effects of these flood control measures are reflected in this study. The recorded 1955 peak discharge on the Lackawaxen River at the Hawley gage was 51,900 cubic feet per second (cfs). By comparison, the estimated regulated 100-year discharge in this vicinity is now 30,700 cfs.

Residents of the community depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the National Oceanic and Atmospheric Administration Flood Forecasting Centers located at Harrisburg, Pennsylvania, and Trenton, New Jersey.

## 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

### 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analysis for the Delaware River was obtained from the Flood Insurance Studies for the Towns of Highland and Tusten, New York (References 1 and 2).

Estimates of the 100-year recurrence interval flood along the Lackawaxen River in the vicinity of Hawley were adopted from regulated frequency curves developed as part of the Stage 1 Prompton (Modification) study and the Prompton Reservoir Regulation Manual (Reference 3). A discharge versus drainage area proportion was used to determine flows downstream of the Borough of Hawley.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGE (cfs) 100-YEAR |
|---|---|---|
| LACKAWAXEN RIVER | | |
| At confluence with Delaware River | 597 | 42,000* |
| At Hawley gage (No. 01431500) | 290 | 30,700* |
| DELAWARE RIVER | | |
| At USGS gage at Port Jervis (No. 01434000) | 3,076 | 170,000** |
| At USGS gage near Barryville (No. 01428500) | 2,025 | 150,000** |

*Discharge regulated by Jadwin, Prompton, and Wallenpaupack Reservoirs
**Regulated annual peak discharge from the Delaware River Basin Commission Hydrology Coordinating Committee

### 3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis for the streams studied by detailed methods were field surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures (Reference 4).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations for the Delaware River were obtained from the Flood Insurance Studies for the Towns of Highland and Tusten, New York (References 1 and 2). Water-surface elevations of floods of the selected recurrence intervals for the Lackawaxen River were computed using the COE HEC-2 step-backwater computer program (Reference 5). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water-surface elevation for the downstream portion of the Delaware River was calculated by the slope/are method; for the upstream portion, the starting water-surface elevation was determined using a rating curve for the USGS gage near Barryville. The starting water-surface elevation for the Lackawaxen River was determined from normal depth computations. The results of the water-surface elevations for the Lackawaxen River are tabulated for selected cross sections (Table 2).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas (Reference 6). For the Delaware River, the channel "n" values ranged from 0.034 to 0.037, and the overbank "n" values ranged from 0.040 to 0.120. The roughness values for the Lackawaxen River ranged from 0.045 in the main channel to 0.090 in the overbank area.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

## 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

### 4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross

| FLOODING SOURCE | | STREAM CHANNEL | | | LEFT OVERBANK | | | RIGHT OVERBANK | | | 100 YEAR FLOOD WATER SURFACE ELEVATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE (FT.) | WIDTH (FT.) | DISCHARGE (CFS) | MEAN VELOCITY (FT./SEC.) | WIDTH (FT.) | DISCHARGE (CFS) | MEAN VELOCITY (FT./SEC.) | WIDTH (FT.) | DISCHARGE (CFS) | MEAN VELOCITY (FT./SEC.) | |
| A (1) | 1000 | 230 | (2) | (2) | 125 | (2) | (2) | 15 | (2) | (2) | 822.2 |
| B (1) | 1950 | 135 | (2) | (2) | 10 | (2) | (2) | 375 | (2) | (2) | 822.2 |
| C | 7525 | 195 | 40180 | 13.9 | 40 | 890 | 4.4 | 80 | 920 | 3.7 | 830.2 |
| D | 12575 | 240 | 41030 | 11.5 | 30 | 700 | 3.0 | 15 | 200 | 2.7 | 825.0 |
| E | 20515 | 205 | 31510 | 9.0 | 80 | 240 | 2.4 | 300 | 10250 | 3.3 | 805.7 |
| F | 21840 | 155 | 33080 | 12.0 | 80 | 700 | 3.1 | 150 | 7020 | 4.9 | 791.3 |
| G | 27790 | 140 | 34500 | 13.3 | 230 | 4080 | 3.0 | 30 | 740 | 3.0 | 771.7 |
| H | 34915 | 270 | 38230 | 8.4 | 110 | 810 | 2.3 | 110 | 900 | 2.2 | 750.3 |
| I | 47750 | 190 | 33170 | 9.9 | 40 | 1080 | 3.2 | 125 | 770 | 2.4 | 705.0 |
| J | 51905 | 150 | 30490 | 12.4 | 225 | 4510 | 3.7 | 0 | 0 | 0.0 | 777.1 |
| K | 56490 | 205 | 33580 | 10.3 | 0 | 0 | 0.0 | 125 | 1420 | 2.7 | 767.3 |
| L | 63885 | 210 | 33080 | 11.2 | 15 | 200 | 3.1 | 45 | 1080 | 3.0 | 807.3 |
| M | 68515 | 205 | 30210 | 8.2 | 70 | 420 | 1.2 | 205 | 2370 | 1.0 | 834.3 |
| N | 75050 | 95 | 19170 | 10.3 | 400 | 13270 | 3.4 | 20 | 500 | 3.2 | 857.1 |
| O | 76050 | 105 | 30940 | 12.4 | 55 | 1910 | 4.3 | 10 | 150 | 3.0 | 800.2 |

(1) Topwidth adjusted due to backwater from Delaware River.
(2) Data not available due to topwidth adjustment.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Township of Lackawaxen
Pike County
Pennsylvania

# REGULATORY DATA

Lackawaxen River

section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 7).

For the flooding sources studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for the Township of Lackawaxen (Reference 8).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

## 4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

No floodways were calculated as part of this study; the floodway for the Delaware River was obtained from the Flood Insurance Studies for the Towns of Highland and Tusten, New York (References 1 and 2). Portions of the floodway widths for the Delaware River extend beyond the corporate limits.

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH[2] (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| | | | | | (FEET NGVD) | | | |
| Delaware River | | | | | | | | |
| A | 150 | 614 | 16,931 | 9.6 | 611.9 | 611.9 | 612.8 | 0.9 |
| B | 1,230 | 489 | 12,328 | 13.1 | 612.5 | 612.5 | 613.3 | 0.8 |
| C | 2,315 | 499 | 11,805 | 13.7 | 614.2 | 614.2 | 615.0 | 0.8 |
| D | 3,250 | 483 | 12,924 | 12.5 | 616.2 | 616.2 | 616.9 | 0.7 |
| E | 4,300 | 530 | 14,268 | 11.4 | 617.9 | 617.9 | 618.5 | 0.6 |
| F | 5,390 | 510 | 13,372 | 12.1 | 619.2 | 619.2 | 619.7 | 0.5 |
| G | 5,990 | 560 | 15,559 | 10.4 | 620.9 | 620.9 | 621.5 | 0.6 |
| H | 6,700 | 600 | 17,891 | 9.0 | 622.0 | 622.0 | 622.4 | 0.4 |
| I | 7,760 | 565 | 15,011 | 10.0 | 622.5 | 622.5 | 623.0 | 0.5 |
| J | 8,730 | 550 | 14,167 | 10.6 | 623.3 | 623.3 | 623.8 | 0.5 |
| K | 9,725 | 529 | 13,638 | 11.0 | 624.3 | 624.3 | 624.7 | 0.4 |
| L | 37,060 | 877 | 17,183 | 8.5 | 664.7 | 664.7 | 665.4 | 0.7 |
| M | 38,000 | 1,090 | 19,340 | 7.6 | 665.9 | 665.9 | 666.5 | 0.6 |
| N | 39,180 | 968 | 21,118 | 6.9 | 666.9 | 666.9 | 667.4 | 0.5 |
| O | 39,880 | 700 | 17,033 | 8.6 | 667.3 | 667.3 | 667.8 | 0.5 |
| P | 40,520 | 465 | 10,844 | 13.5 | 668.1 | 668.1 | 668.5 | 0.4 |
| Q | 41,460 | 784 | 20,224 | 7.2 | 671.3 | 671.3 | 671.6 | 0.3 |
| R | 42,560 | 629 | 12,584 | 11.6 | 672.2 | 672.2 | 672.5 | 0.3 |
| S | 43,450 | 449 | 11,473 | 12.4 | 673.3 | 673.3 | 673.6 | 0.3 |
| T | 44,130 | 511 | 13,712 | 10.4 | 674.8 | 674.8 | 675.0 | 0.2 |
| U | 44,790 | 540 | 14,103 | 10.1 | 675.5 | 675.5 | 675.6 | 0.1 |
| V | 45,930 | 481 | 12,593 | 11.0 | 676.4 | 676.4 | 676.5 | 0.1 |
| W | 46,960 | 458 | 12,822 | 11.0 | 677.3 | 677.3 | 677.4 | 0.1 |
| X | 47,680 | 632 | 15,383 | 9.2 | 678.5 | 678.5 | 678.7 | 0.2 |
| Y | 48,350 | 552 | 14,194 | 10.0 | 679.8 | 679.8 | 679.9 | 0.1 |
| Z | 49,120 | 485 | 13,416 | 10.6 | 680.4 | 680.4 | 680.5 | 0.1 |

[1] Feet above corporate limits
[2] This width extends beyond corporate limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**TOWNSHIP OF LACKAWAXEN, PA.**
**(PIKE CO.)**

**FLOODWAY DATA**

**DELAWARE RIVER**

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH[2] (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| | | | | | (FEET NGVD) | | | |
| Delaware River (continued) | | | | | | | | |
| AA | 49,890 | 594 | 15,379 | 9.2 | 681.3 | 681.3 | 681.5 | 0.2 |
| AB | 50,780 | 666 | 16,702 | 8.5 | 682.1 | 682.1 | 682.3 | 0.2 |
| AC | 51,990 | 629 | 16,509 | 8.6 | 682.8 | 682.8 | 683.0 | 0.2 |
| AD | 53,040 | 574 | 16,110 | 8.8 | 683.4 | 683.4 | 683.6 | 0.2 |
| AE | 54,000 | 509 | 12,591 | 11.3 | 683.8 | 683.8 | 684.0 | 0.2 |
| AF | 54,885 | 445 | 11,114 | 12.8 | 684.7 | 684.7 | 684.9 | 0.2 |
| AG | 55,770 | 528 | 13,899 | 10.2 | 686.8 | 686.8 | 686.8 | 0.0 |
| AH | 56,790 | 660 | 17,834 | 8.0 | 687.9 | 687.9 | 688.1 | 0.2 |
| AI | 58,010 | 563 | 14,738 | 9.6 | 688.4 | 688.4 | 688.6 | 0.2 |
| AJ | 59,000 | 725 | 18,220 | 7.8 | 689.2 | 689.2 | 689.7 | 0.5 |
| AK | 60,120 | 685 | 15,439 | 9.2 | 689.6 | 689.6 | 690.2 | 0.6 |
| AL | 60,840 | 606 | 15,459 | 9.2 | 690.5 | 690.5 | 690.9 | 0.4 |
| AM | 61,520 | 604 | 14,631 | 9.7 | 691.0 | 691.0 | 691.4 | 0.4 |
| AN | 61,970 | 616 | 15,924 | 8.9 | 691.6 | 691.6 | 691.9 | 0.3 |
| AO | 62,690 | 659 | 17,660 | 8.0 | 692.2 | 692.2 | 692.6 | 0.4 |
| AP | 63,490 | 740 | 18,617 | 7.6 | 692.7 | 692.7 | 693.1 | 0.4 |
| AQ | 64,900 | 711 | 17,632 | 8.0 | 693.4 | 693.4 | 693.7 | 0.3 |
| AR | 65,600 | 737 | 17,907 | 7.9 | 693.7 | 693.7 | 694.1 | 0.4 |

[1]Feet above corporate limits
[2]This width extends beyond corporate limits

TABLE 3

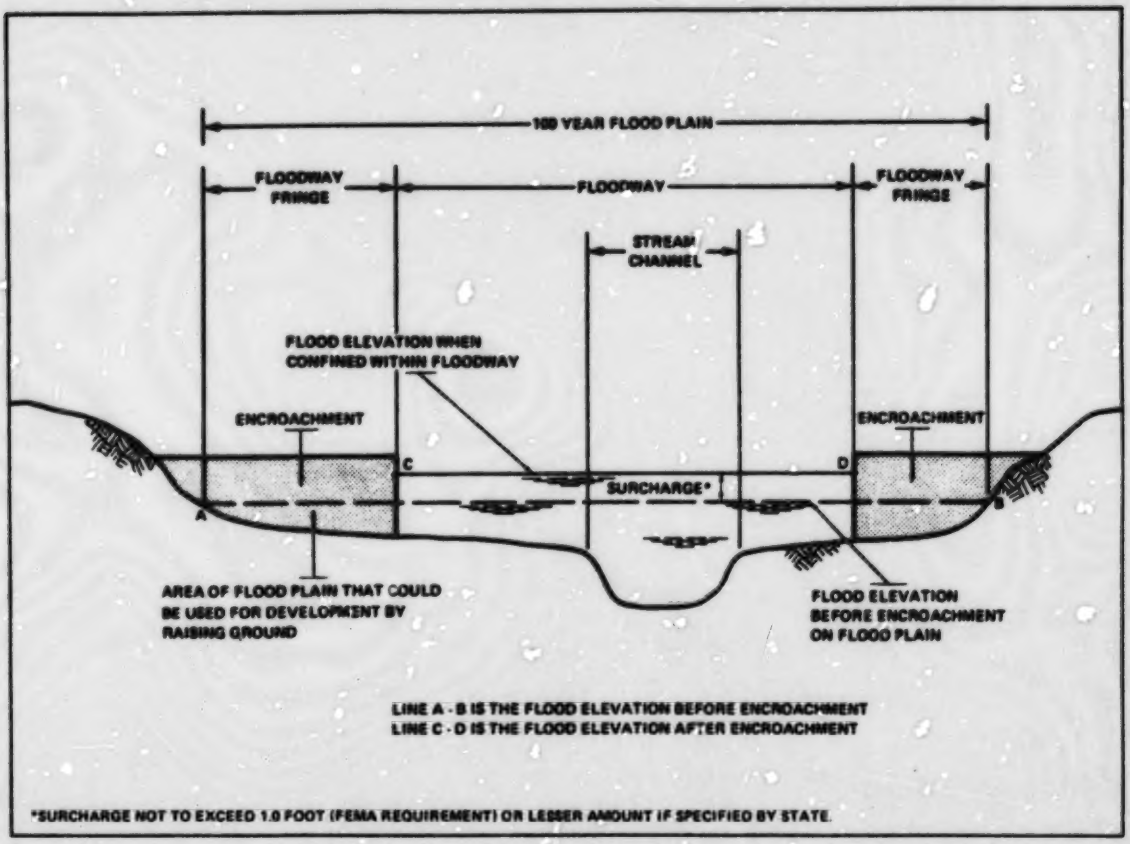
FEDERAL EMERGENCY MANAGEMENT AGENCY

**TOWNSHIP OF LACKAWAXEN, PA.**
**(PIKE CO.)**

**FLOODWAY DATA**

**DELAWARE RIVER**

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

## 5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.



BEST COPY AVAILABLE

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 10-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

## 6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

## 7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Towns of Highland and Tusten, New York; and the Borough of Hawley (References 1, 2, and 9). The results of this study are in complete agreement with the results of those studies.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Lackawaxen (Reference 8).

## 8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

## 9.0 BIBLIOGRAPHY AND REFERENCES


1. Federal Emergency Management Agency, Flood Insurance Study, Town of Highland, Sullivan County, New York, Washington, D. C., March 4, 1987.

2. Federal Emergency Management Agency, Flood Insurance Study, Town of Tusten, Sullivan County, New York, Washington, D. C., February 19, 1987.

3. Stage 1 Prompton (Modification) Study (Unpublished).

4. U. S. Army Corps of Engineers, "Field Surveys, Lackawaxen River," Philadelphia, Pennsylvania, 1984.

5. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, 1982.

6. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

7. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Shohola, Pennsylvania-New York, 1965, Photorevised 1983; Rowland, Pennsylvania, 1966, Photorevised 1983; Hawley, Pennsylvania, 1966, Photorevised 1983; Eldred, New York-Pennsylvania, 1967; Narrowsburg, Pennsylvania, New York, 1968.

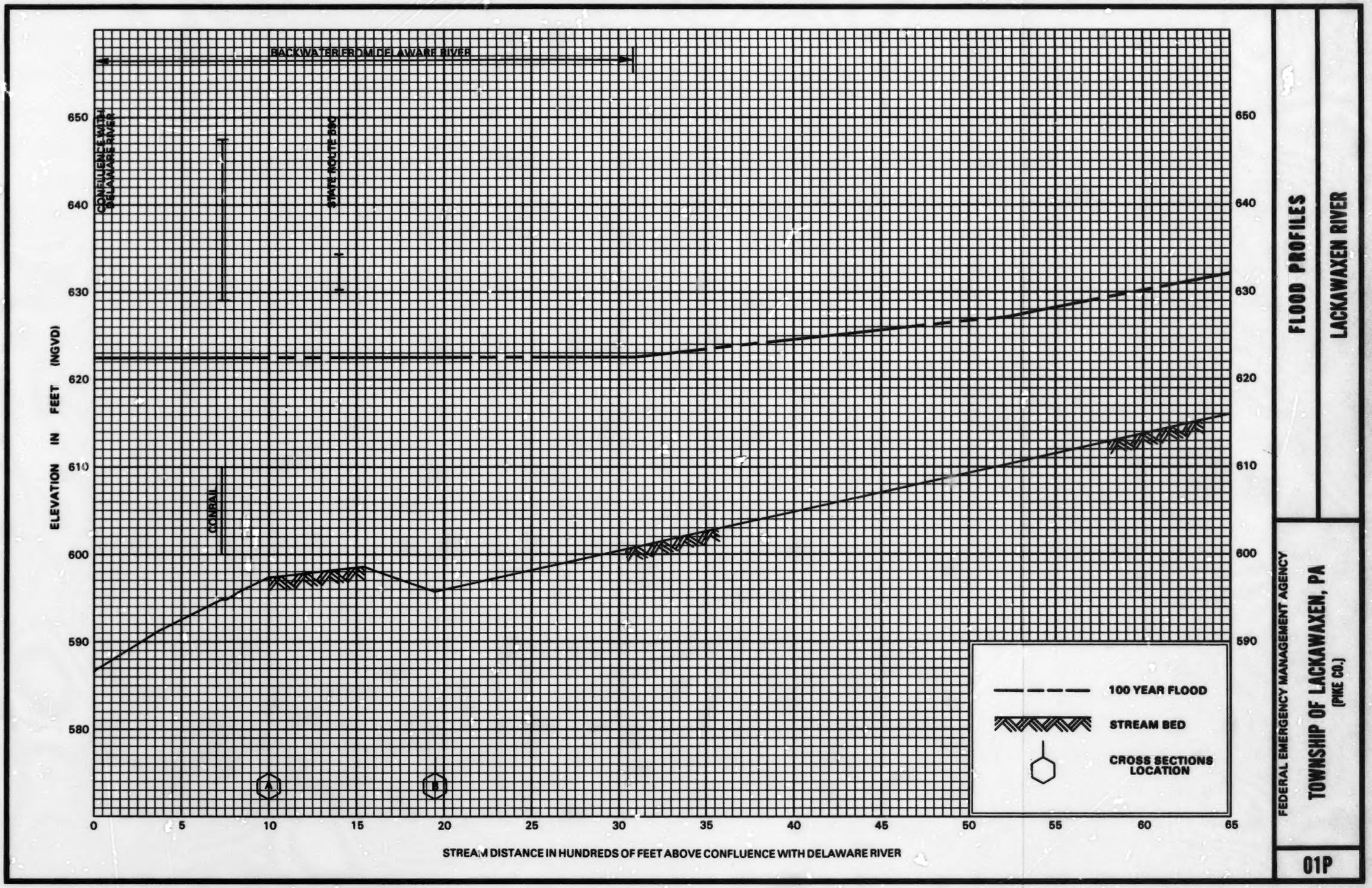
8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Lackawaxen, Pike County, Pennsylvania, January 11, 1980.

9. Federal Emergency Management Agency, Flood Insurance Study, Borough of Hawley, Pike County, Pennsylvania, Washington, D. C., August xx, 1986.

Community Map, General Highway Map, Pike County, Pennsylvania, prepared by the Pennsylvania Department of Transportation, 1981.

## EXHIBIT 3 - ELEVATION REFERENCE MARKS

| Reference Mark | FIRM Panel | Elevation (Feet NGVD) | Description of Location |
|---|---|---|---|
| RM 1 | 10 | 681.20 | NGS disk stamped P-149 1941 set in west end of south stone abutment of CONRAIL bridge over the Delaware River, 15 feet west of west rail of south bound track. |
| RM 2 | 20 | 681.81 | NGS disk stamped Q-149 1941 set in boulder in line with rock fence, 1.4 miles north along CONRAIL from Mast Hope Station, 56 feet northwest of pole E56, 45 feet west of west rail of south bound track. |
| RM 3 | 25 | 842.00 | Kimbles Road bridge over the Lackawaxen River. Square cut at southeast corner of bridge in top of downstream bridge wall at east abutment. |
| RM 4 | 30 | 690.87 | Rowland Road bridge over Lackawaxen River. Square cut on top end of downstream bridge wall at north abutment. |
| RM 5 | 30 | 638.73 | State Route 590 bridge over Lackawaxen River. PDH disk set on top of upstream wing wall on north abutment. |
| RM 6 | 30 | 646.41 | CONRAIL Railroad bridge over the Lackawaxen River. Square cut at northeast corner of bridge on southeast corner of north abutment. |
| RM 7 | 30 | 637.37 | USGS disk stamped PRIM TRAV STA NO 2 set in stone wall, 400 feet northwest of CONRAIL station at Lackawaxen, 50 feet northeast of fork in road to Roebling Bridge. |
| RM 8 | 30 | 651.00 | NGS disk stamped W-149 set in stone cut, 1 mile east along CONRAIL tracks from Lackawaxen Station, 5 feet south of south rail of east bound track. |




FLOOD PROFILES

LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

01P

ELEVATION IN FEET (NGVD)

660
650
640
630
620
610

680
650
640
630
620
610

C
D

100 YEAR FLOOD
STREAM BED
CROSS SECTIONS LOCATION

65 70 75 80 85 90 95 100 105 110 115 120 125 130

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH DELAWARE RIVER

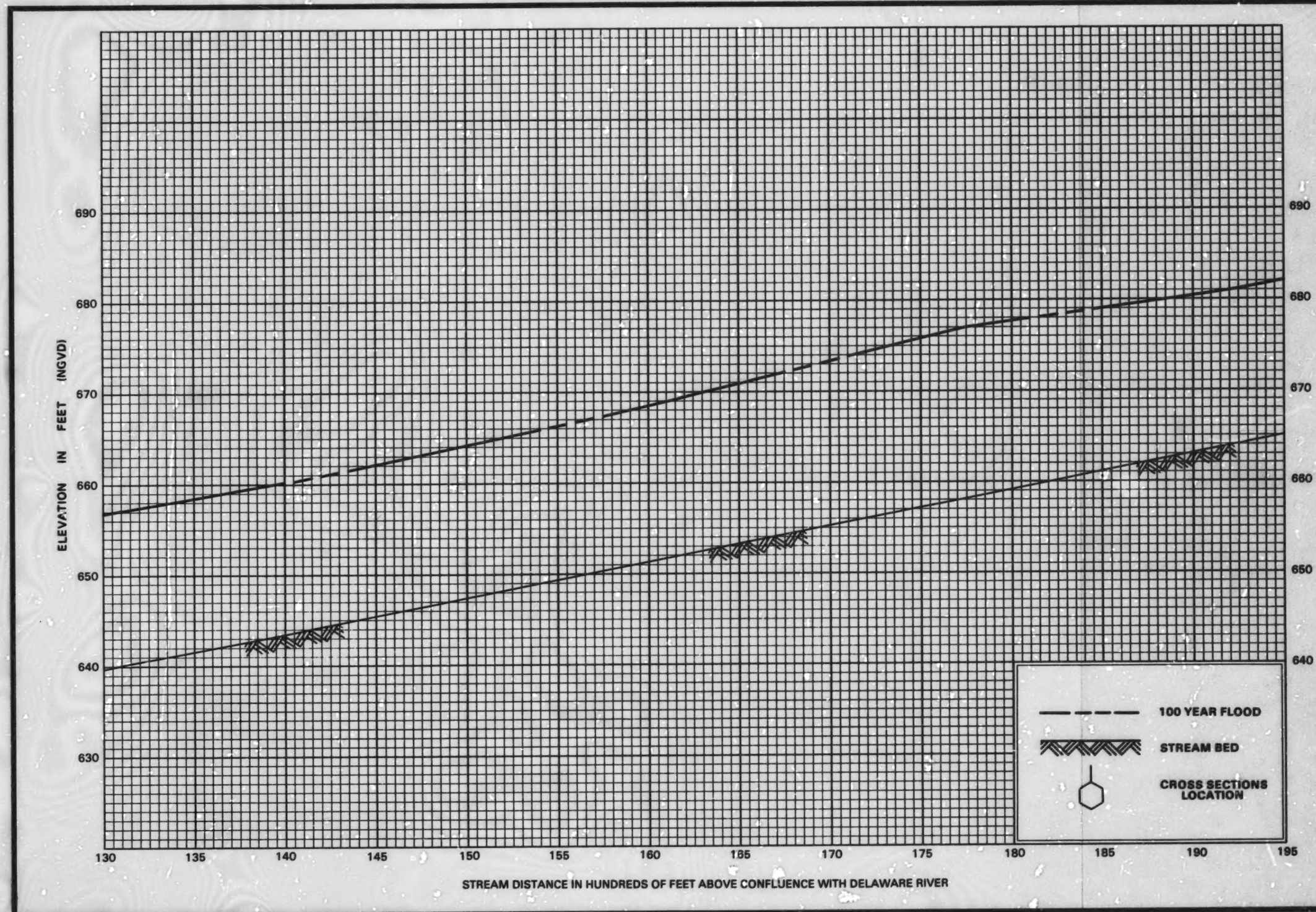
# FLOOD PROFILES

## LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

02P




# FLOOD PROFILES

## LACKAWAXEN RIVER

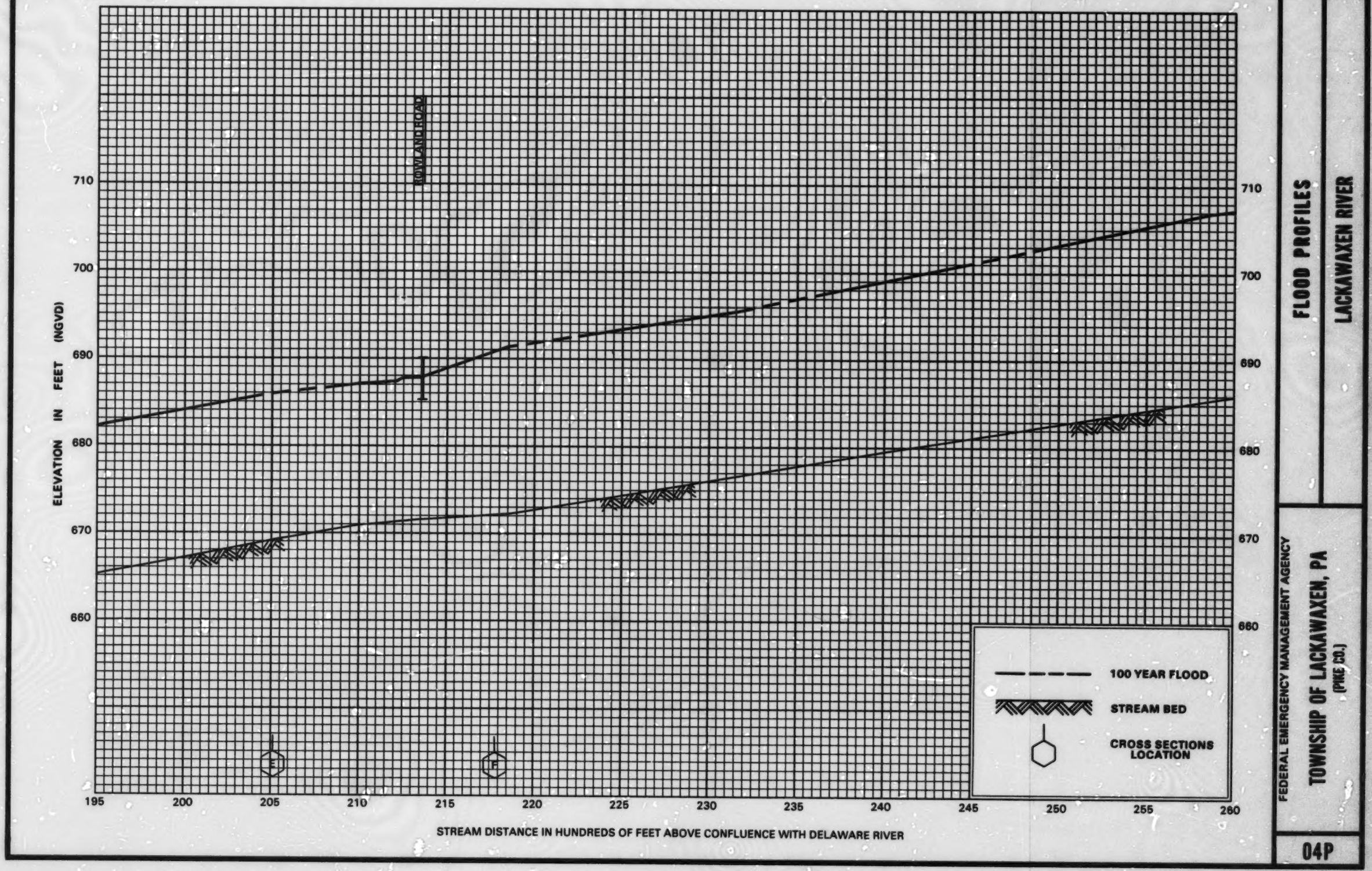
FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA

(PIKE CO.)

03P

19




FLOOD PROFILES

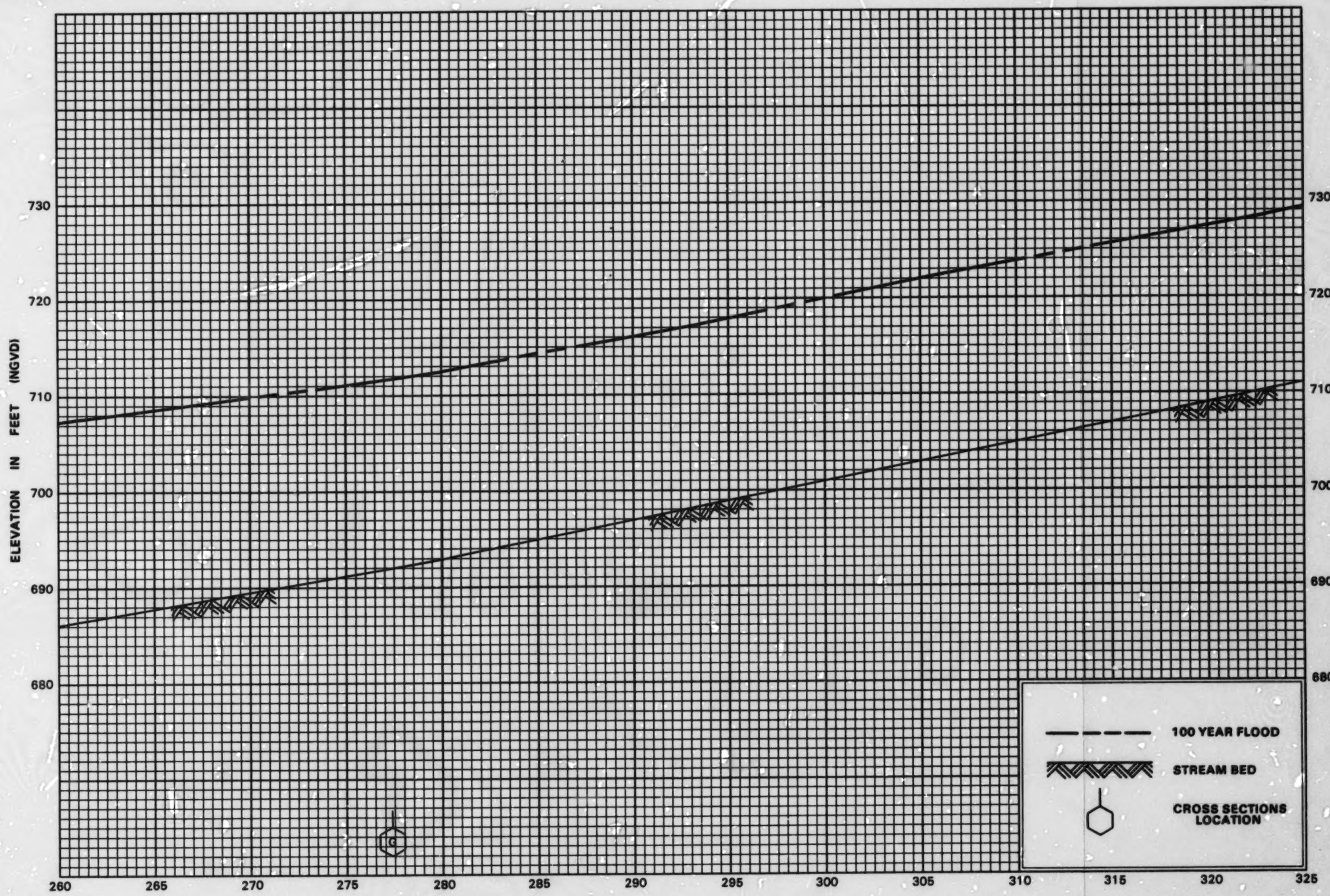
LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

04P

20




# FLOOD PROFILES

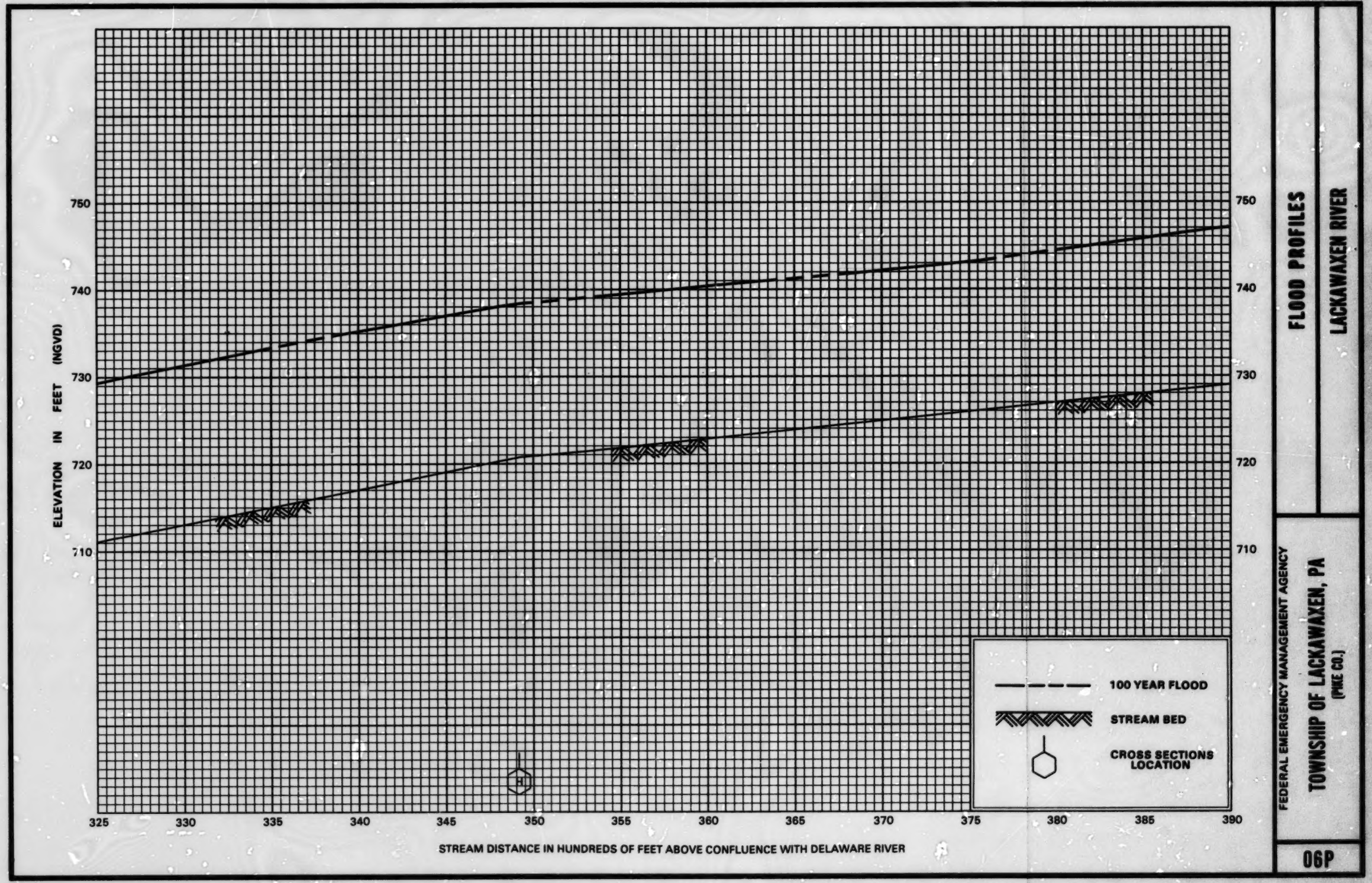
## LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA

(PIKE CO.)

05P



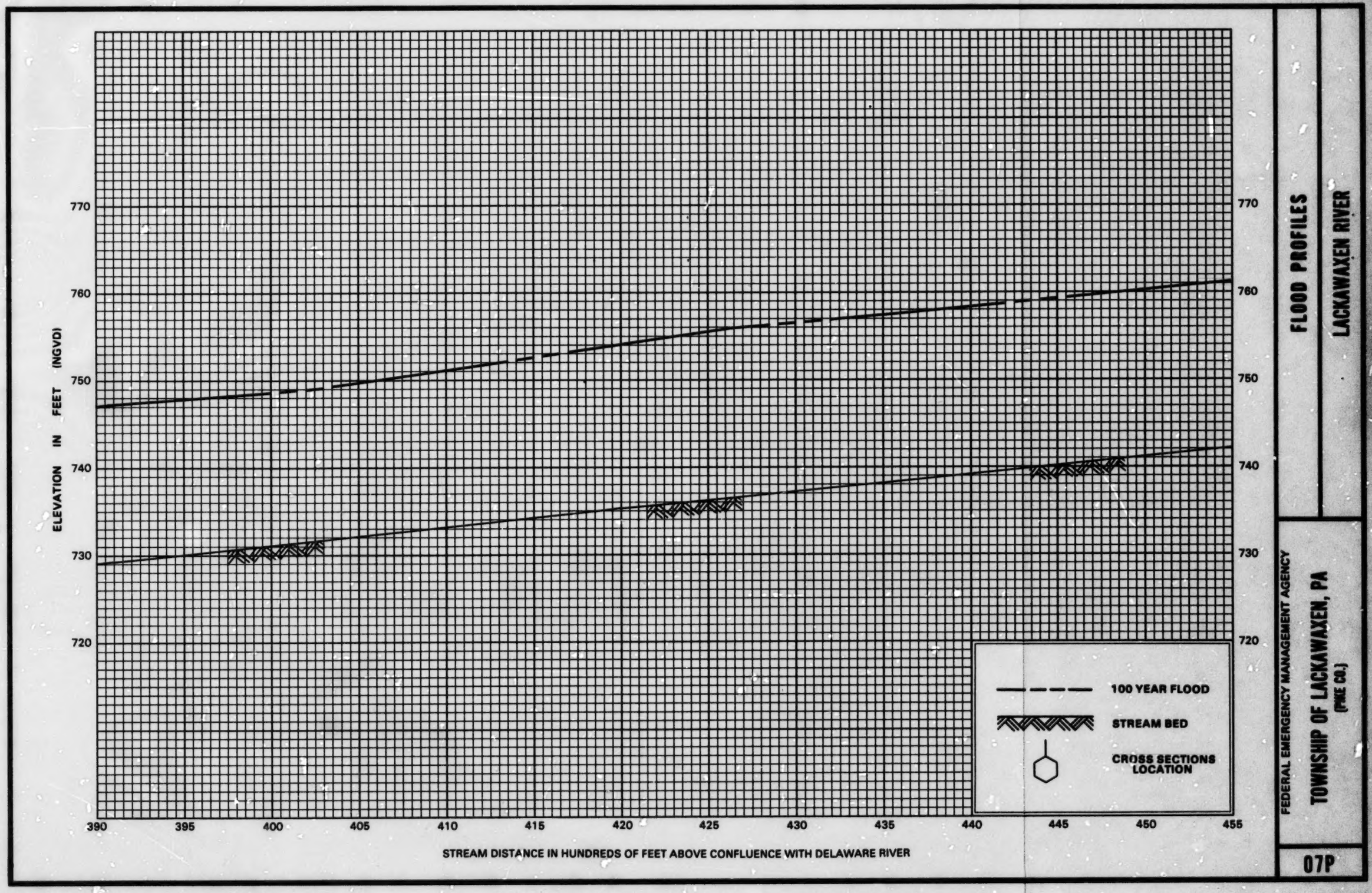

FLOOD PROFILES

LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

06P




# FLOOD PROFILES

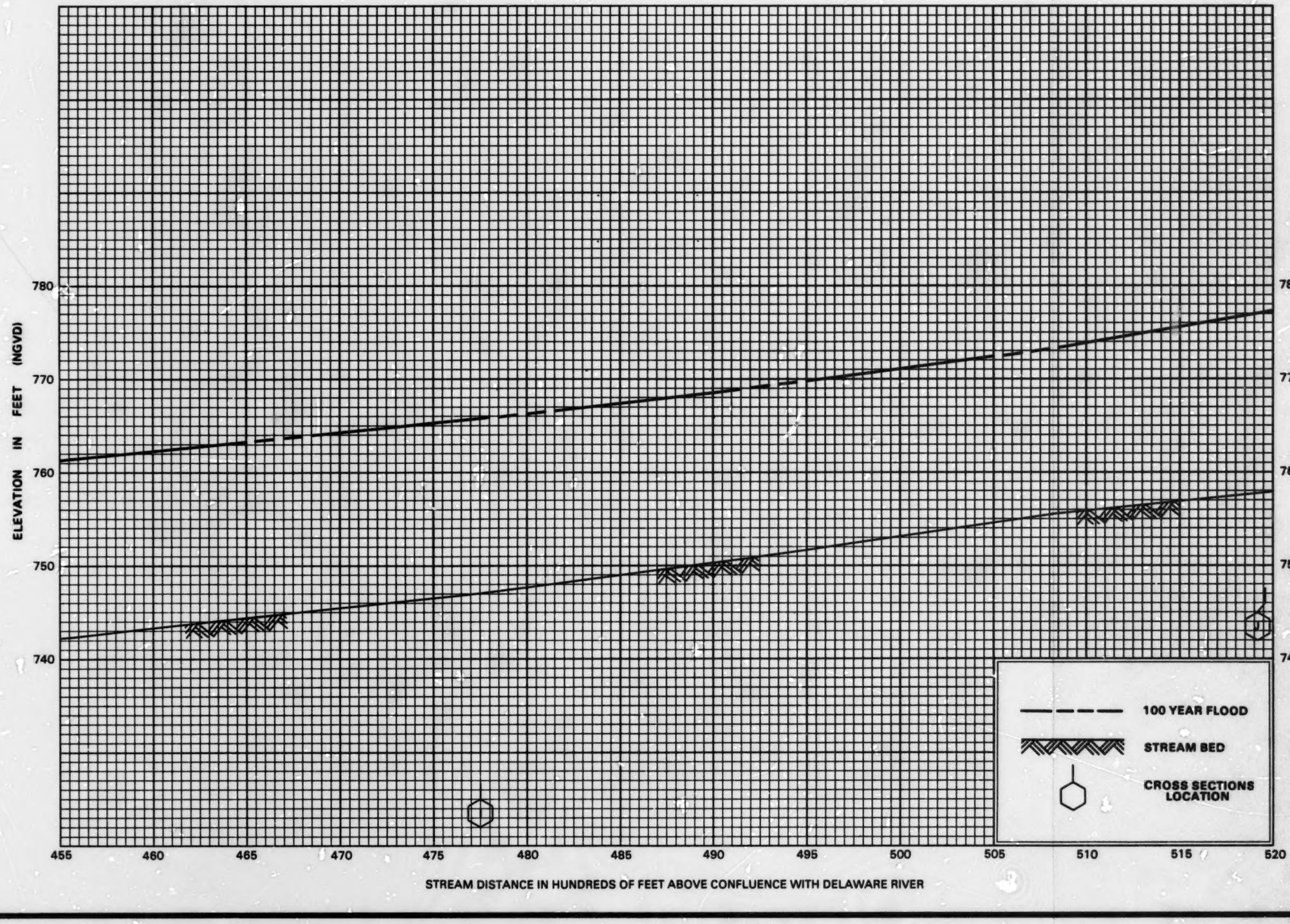
## LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA

(PIKE CO.)

07P



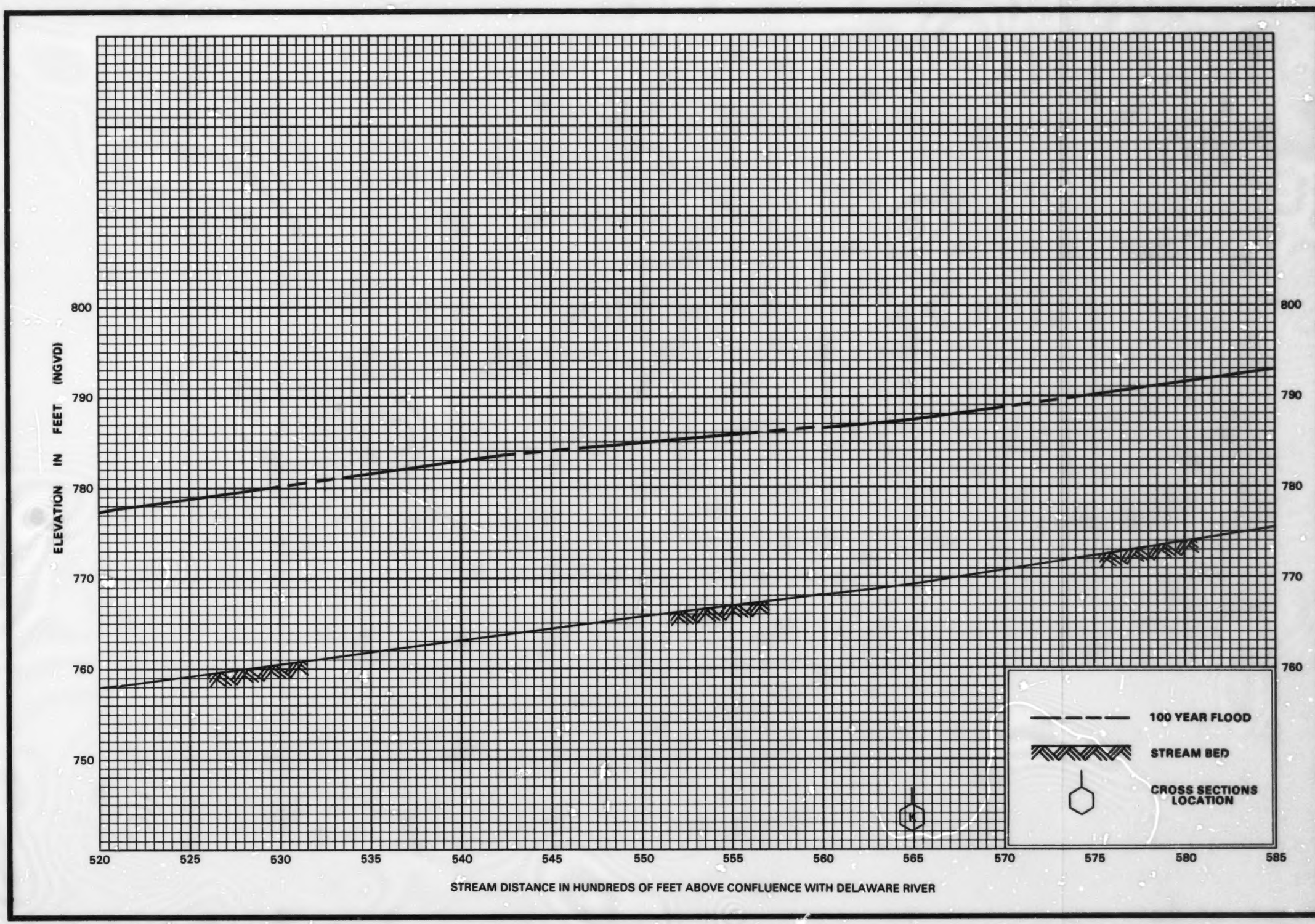

FLOOD PROFILES

LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

08P



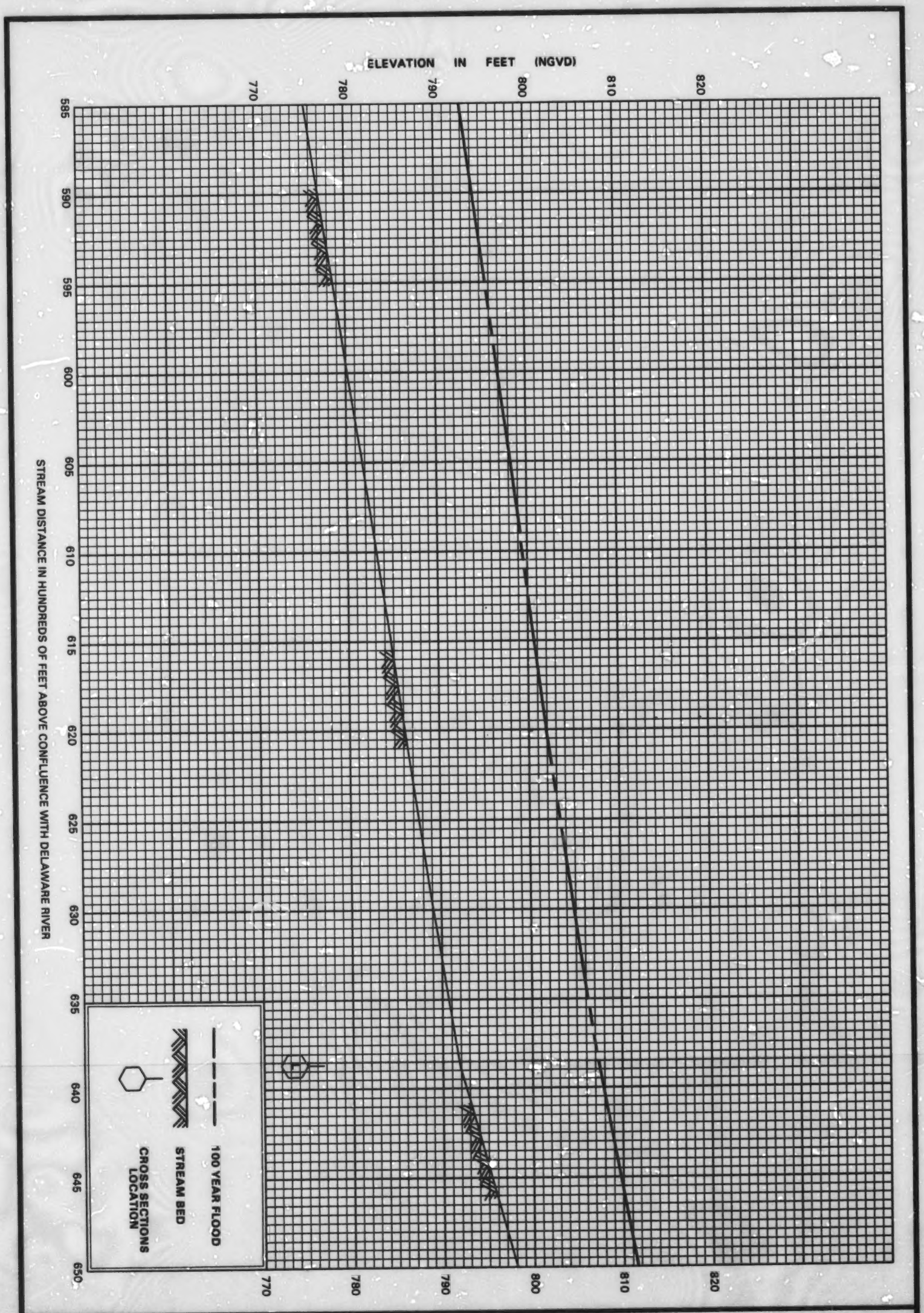

FLOOD PROFILES

LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

09P




10P

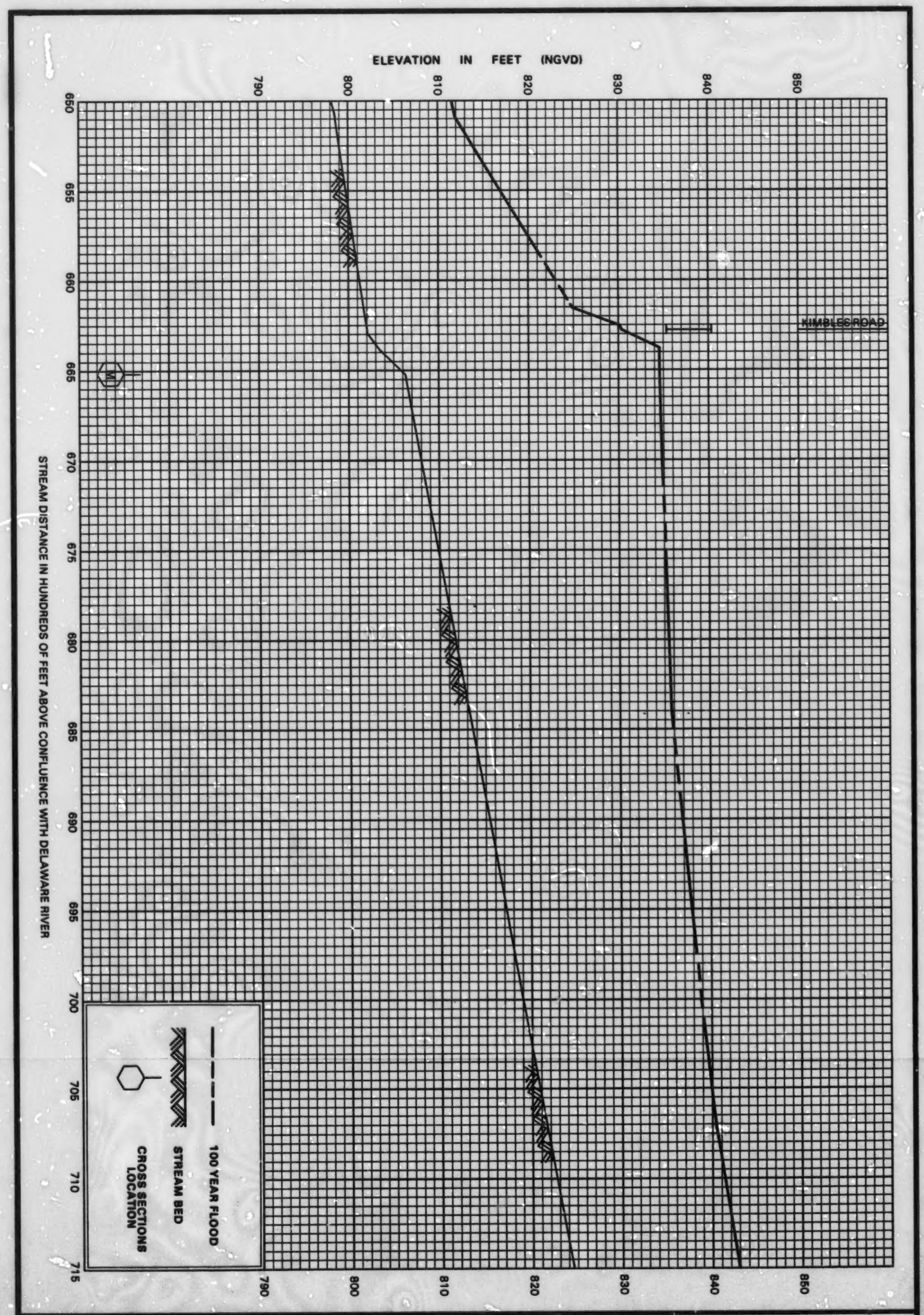
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

FLOOD PROFILES

LACKAWAXEN RIVER

26




FEDERAL EMERGENCY MANAGEMENT AGENCY

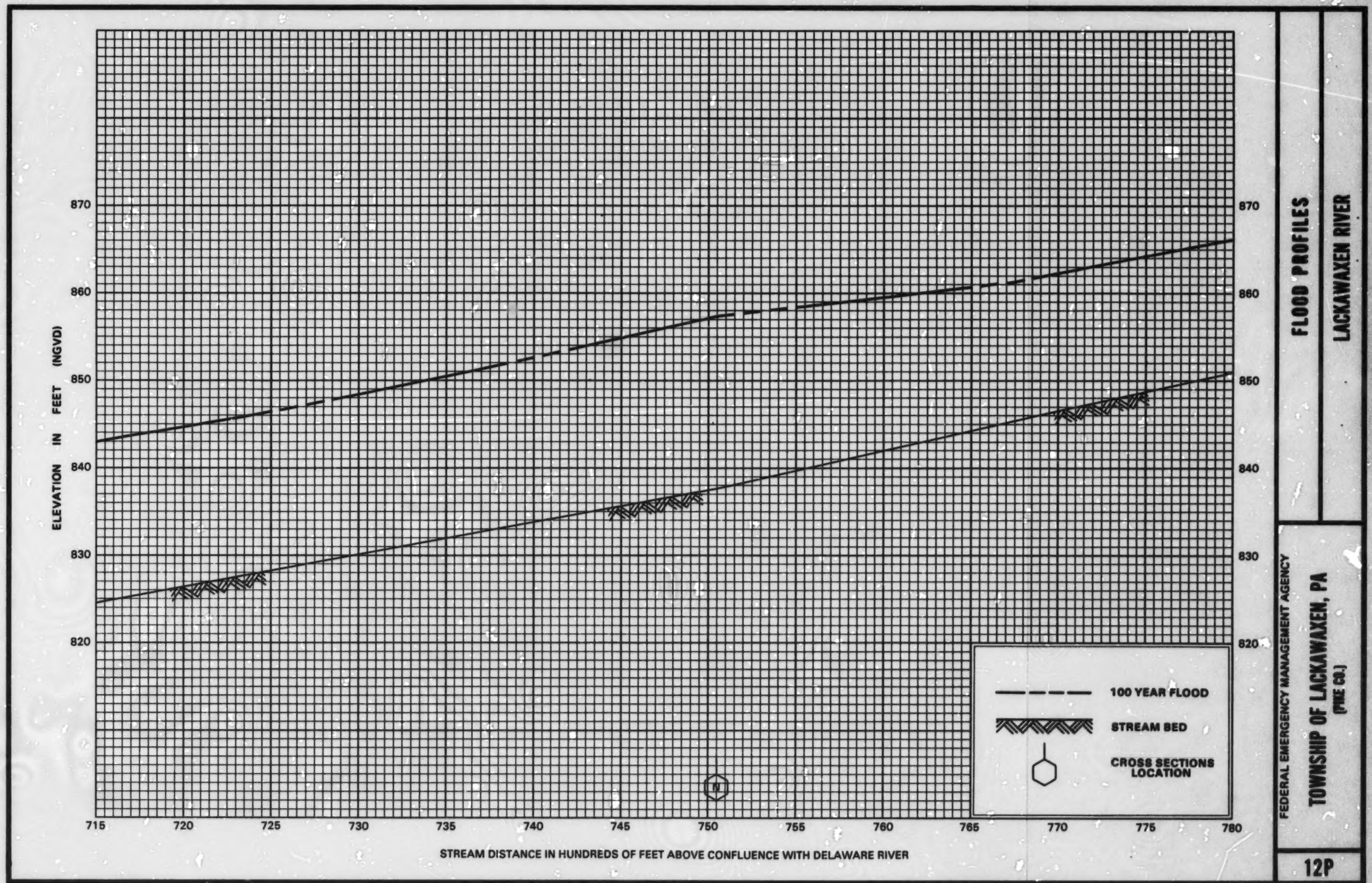
**TOWNSHIP OF LACKAWAXEN, PA**

(PIKE CO.)

11P

**FLOOD PROFILES**

**LACKAWAXEN RIVER**




FLOOD PROFILES

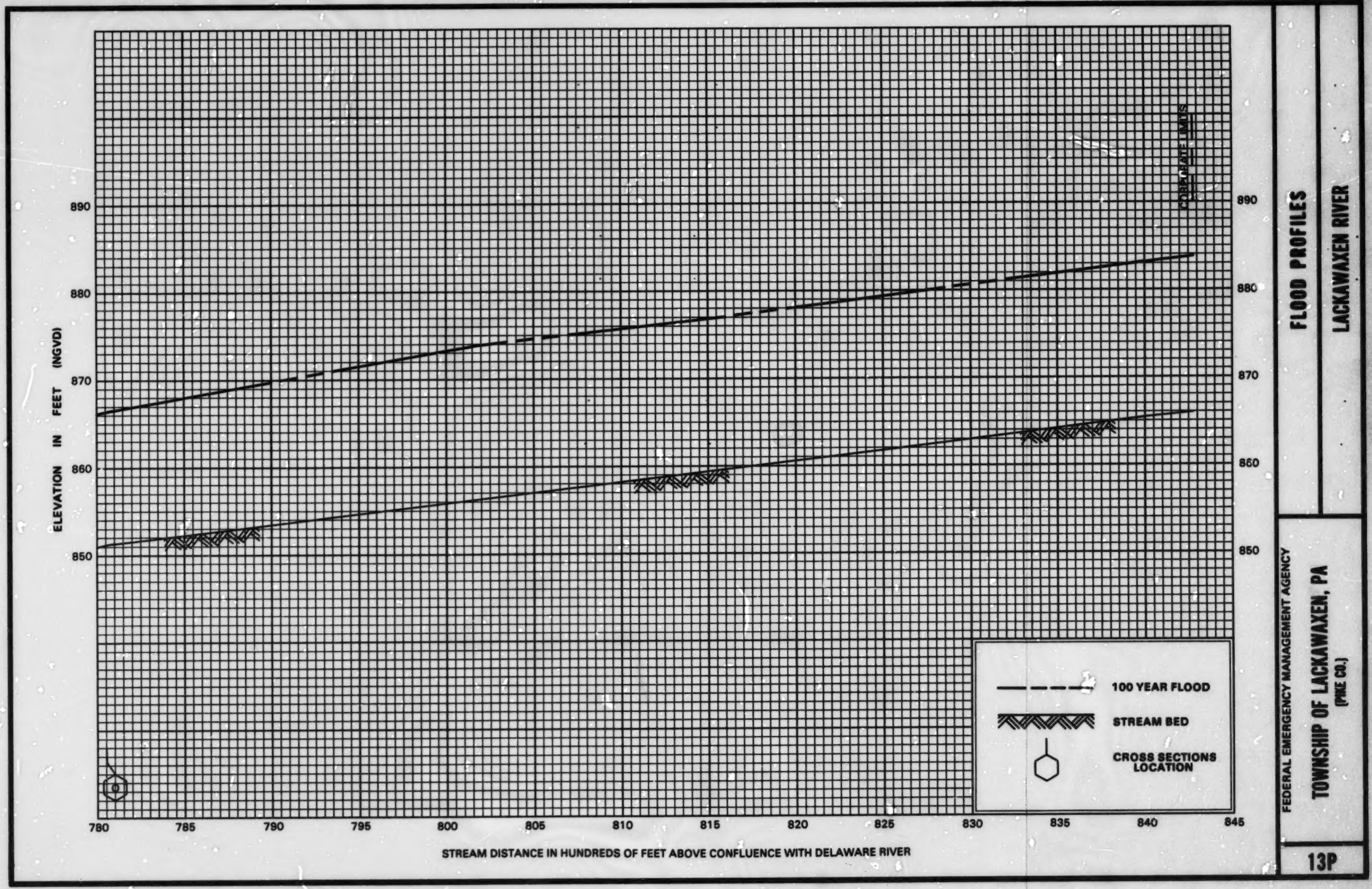
LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

12P

28



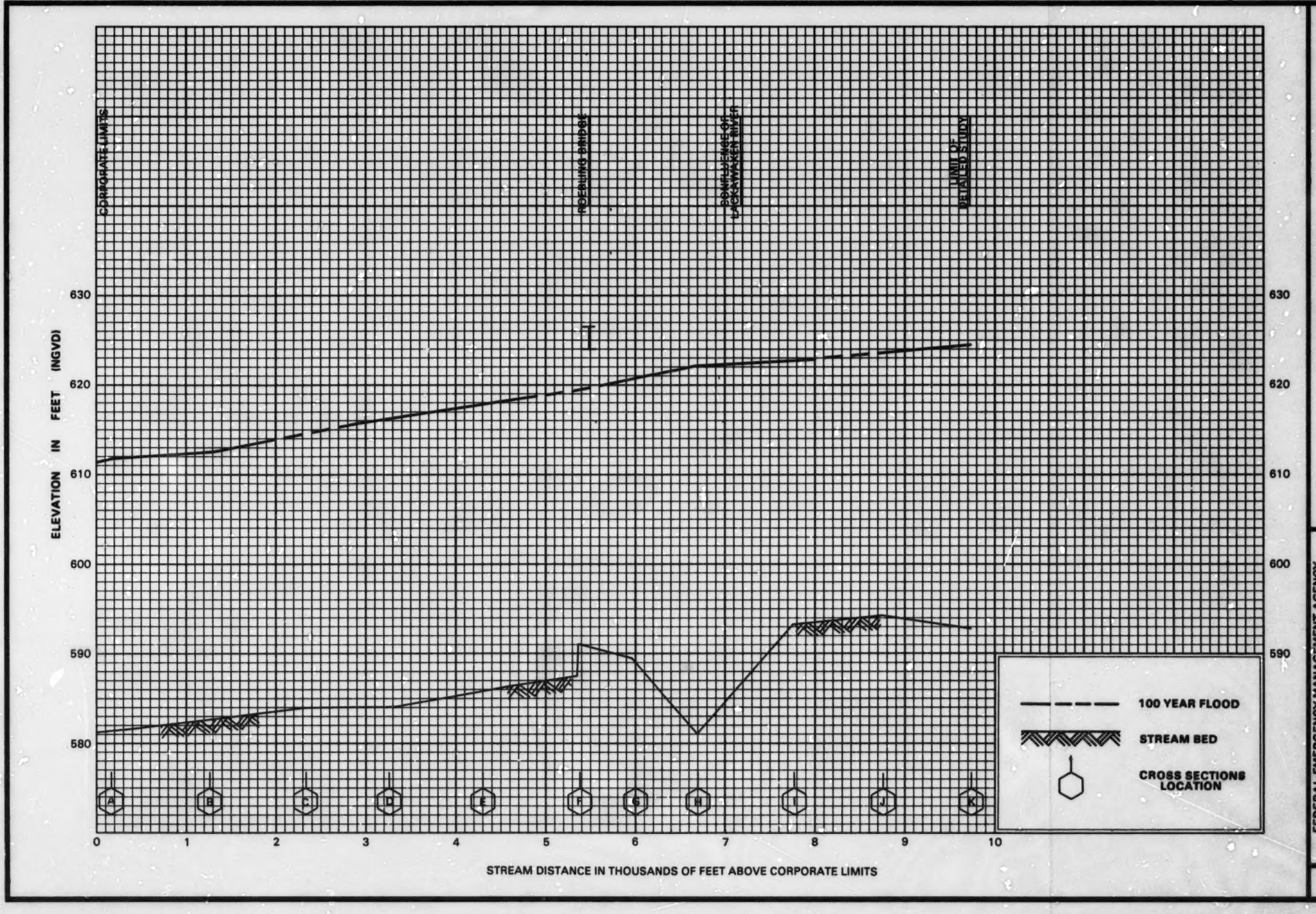

FLOOD PROFILES

LACKAWAXEN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

13P



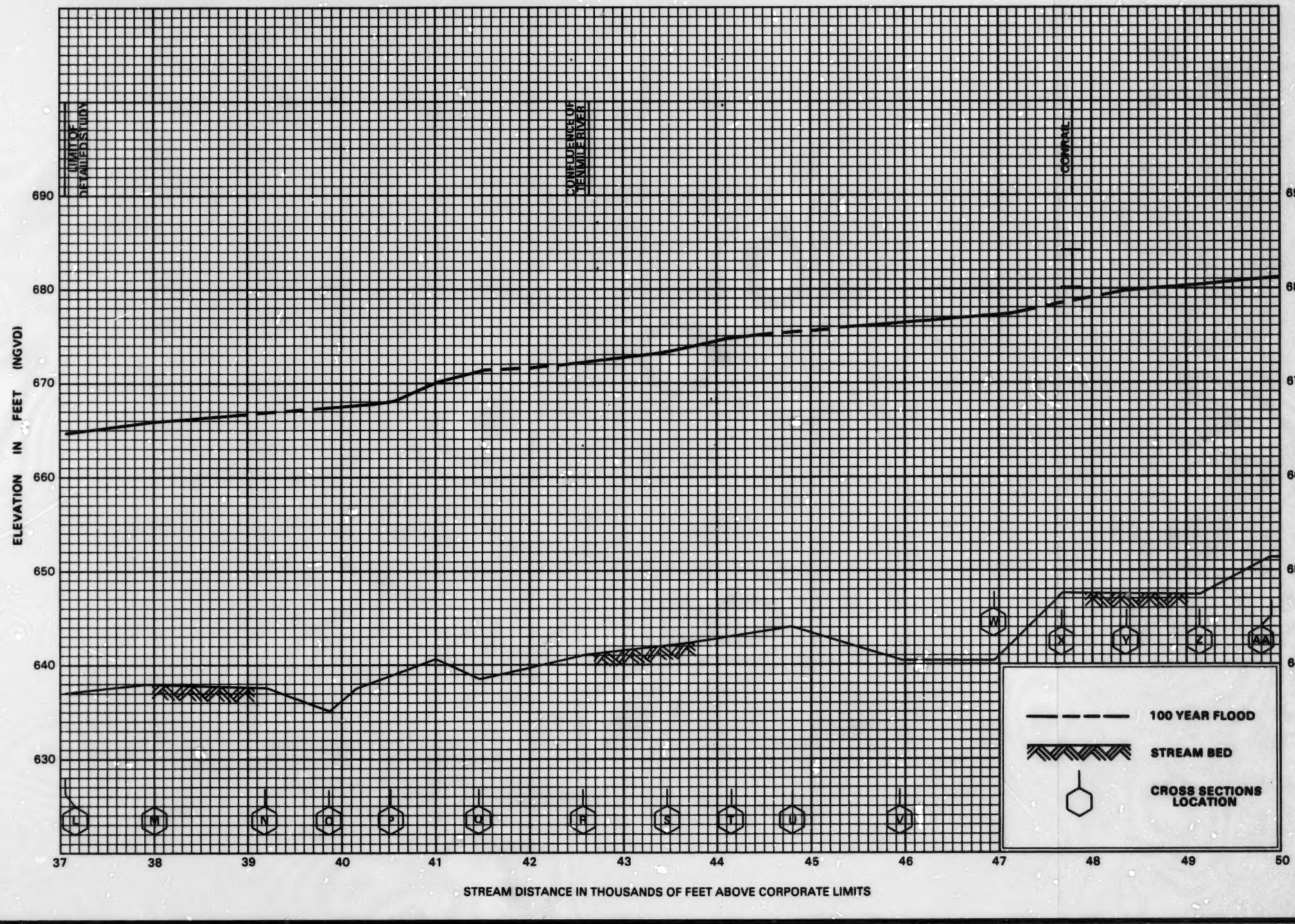

FLOOD PROFILES

DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

14P




FLOOD PROFILES

DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

15P

ELEVATION IN FEET (NGVD)

700
690
680
670
660
650
640

AB AC AD AE AF AG AH AI AJ AK AL AM AN AO

100 YEAR FLOOD
STREAM BED
CROSS SECTIONS LOCATION

50 51 52 53 54 55 56 57 58 59 60 61 62 63

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS

# FLOOD PROFILES

## DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA
(PIKE CO.)

16P

# FLOOD PROFILES

## DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

## TOWNSHIP OF LACKAWAXEN, PA

(PIKE CO.)

17P